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Synchrotron-radiation-based ^{174}Yb Mössbauer spectroscopy of Au-Al-Yb Approximant

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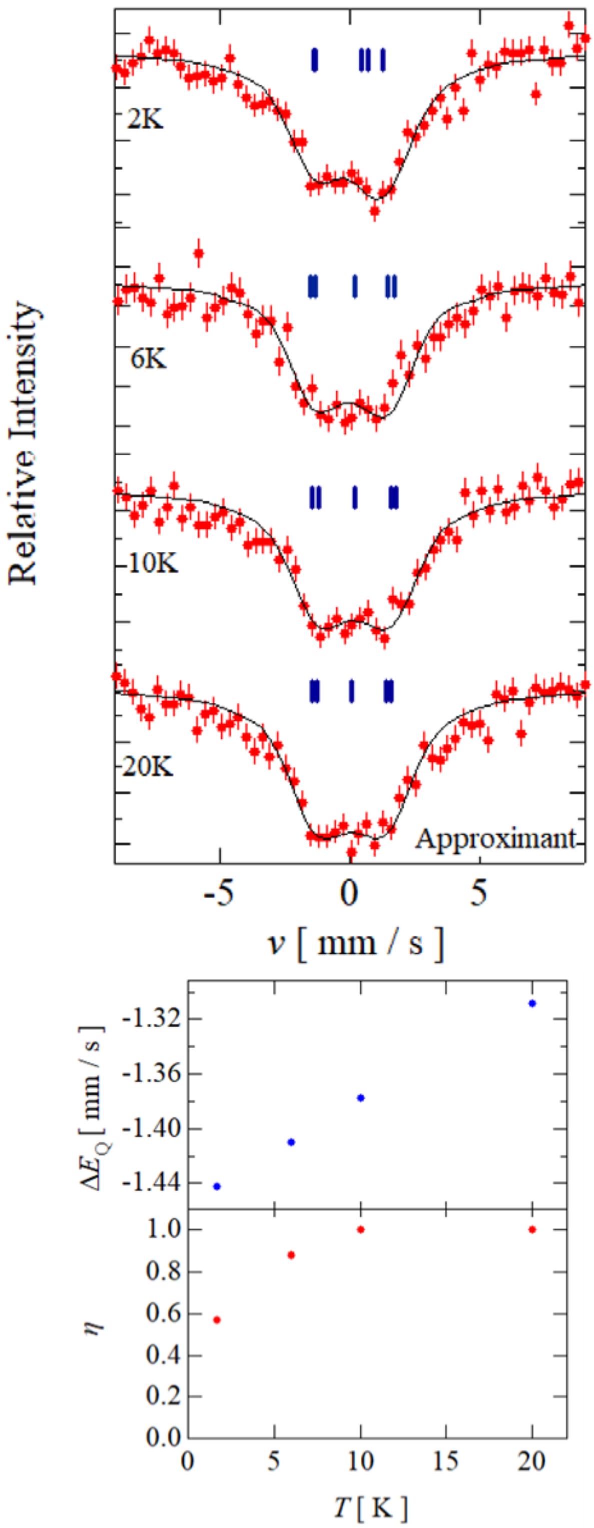
Atomic arrangements of quasicrystals are quasiperiodic and then quasicrystals possess rotation symmetries which are not allowed in periodic crystals, that is, five-fold symmetry. Thus, quasicrystals show physical properties which are not observed in periodic crystals. The Au-Al-Yb quasicrystal exhibits quantum critical phenomena at low temperature at ambient pressure and this quantum critical is robust against pressure. Meanlwhile, the Au-Al-Yb approximant does not show quantum criticality at ambient pressure and quantum criticality appears at 1.7 GPa[1] in the approximant.

The future goal of our study is to investigate the origin of quantum criticality unique to quasicrystals by probing the quantum criticality of approximant crystals from the electronic state. In this presentation, we have performed synchrotron-radiation (SR) -based ^{174}Yb Mössbauer spectroscopy[2] to measure the spectra for the approximant as a function of temperature. Figure1 presents the observed ^{174}Yb Mössbauer spectra for the Au-Al-Yb approximant. As shown in the analytical spectra presented by solid lines are well fitted to observed ones. Figure 2 2shows the evaluated values of the electric-field gradient, E_Q and η, as a function of temperature. These values are not explained by simple $J_z = \pm 7/2$ wavefunction of a Yb^{3+} ion with averaged valence correction.

[1] K. Deguchi et al., Nature Materials 11, (2012) 1013.

[2] H. Kobayashi et al., science 379 (2023) 908.



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